Identifying Energy Efficiency Strategies for Laboratories

LABS 21

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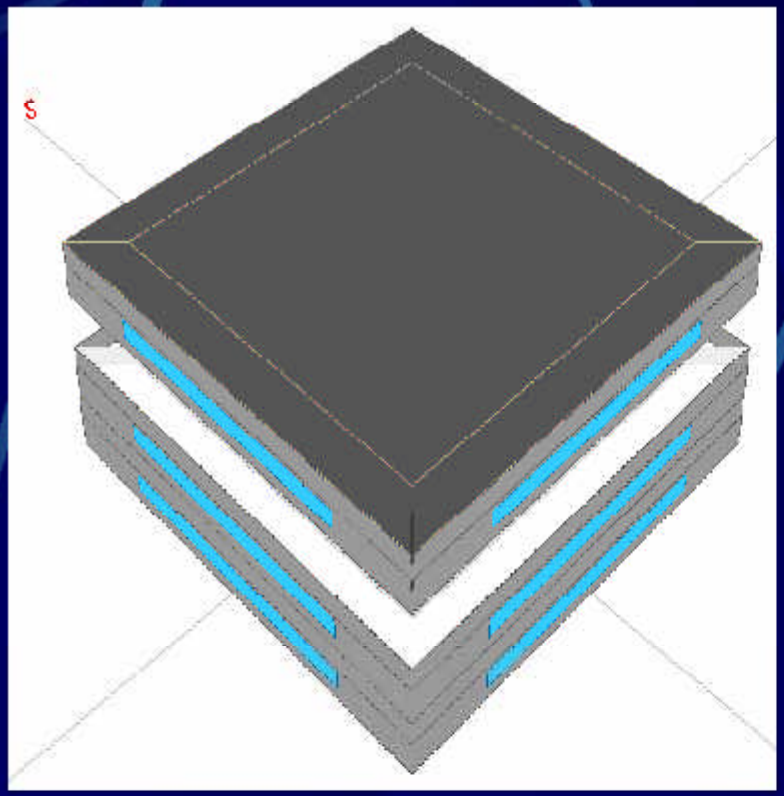
Building Model



- 100,000 net sf
- CAV w/ hot water reheat
- 74F/72F w/ Min 30% RH, Max 60% RH
- Chillers: 0.5 kW/ton
- Boilers: 80% η
- Electricity: $0.03/kWh, $7/kW
- Gas: $0.6/therm

LABS FOR THE 21ST CENTURY

Climates

	Minneapolis	Denver	Seattle	Atlanta
Winter design temperature (F)	-11	3	28	23
Summer design temperature (F)	88/77	90/59	81/64	91/74
HDD65 (F-days)	8002	6113	4867	3089
CDD65 (F-days)	634	566	127	1611

Internal Loads

Plug Loads

- Perimeter-10 W/sf
- Core – 8.52 W/sf

Lighting

- Perimeter-1.8 W/sf
- Core – 1.4 W/sf

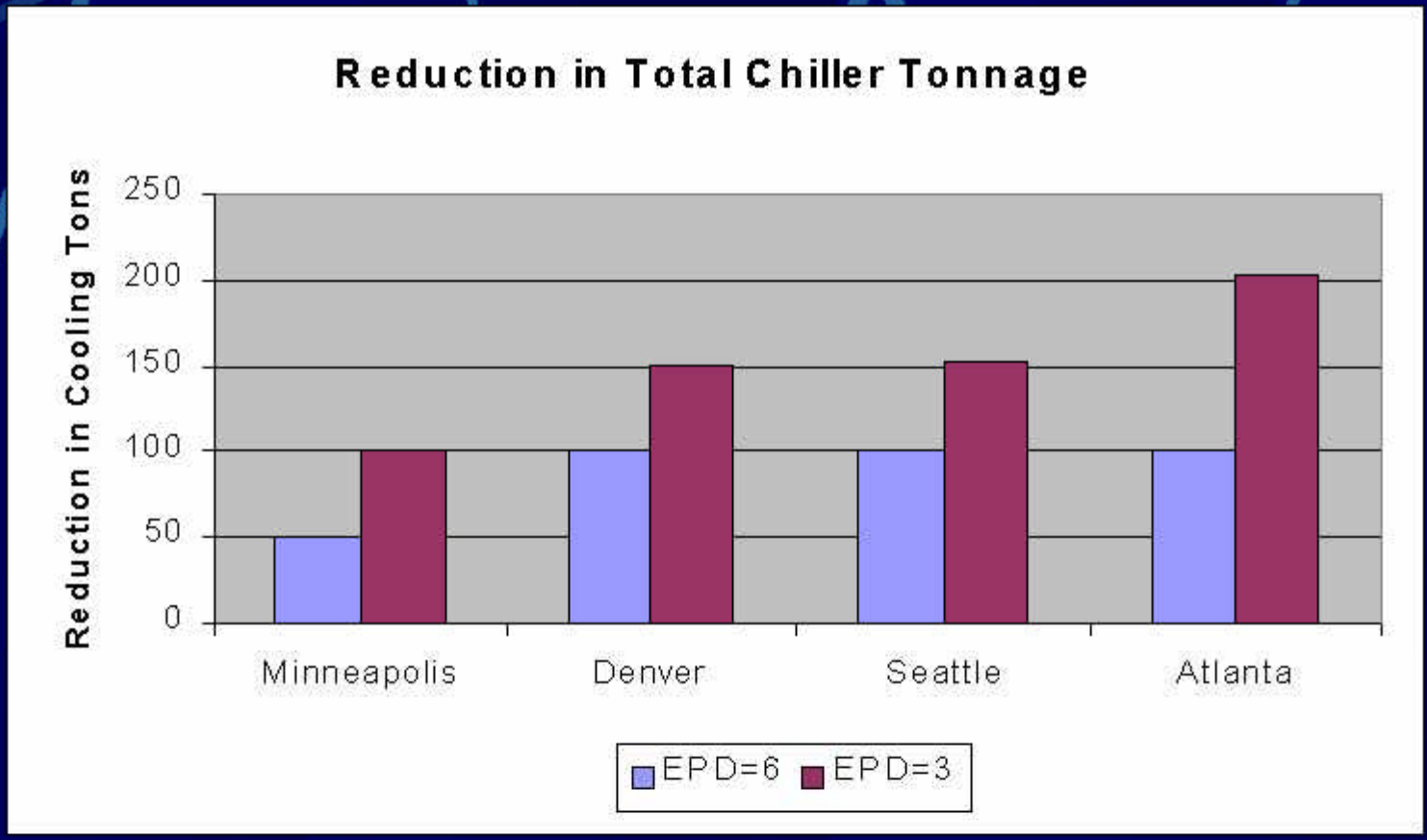
People

•275 sf/per

8am-10pm, M-F

All Loads Scheduled

Effect of Plug Load Assumption



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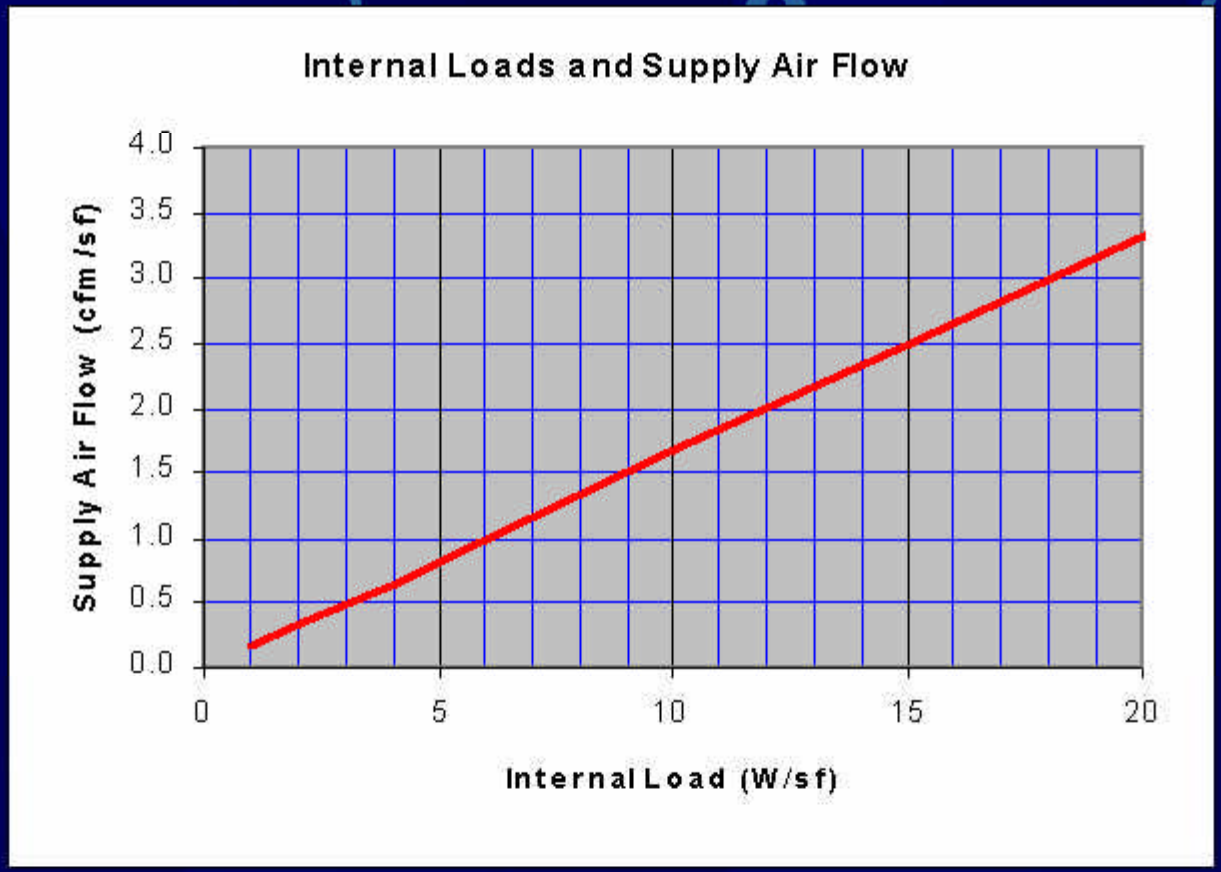
How Much Air?



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Outside Air Requirements

Fume Hoods

- 1 hood/450 sf
- 18" high, 6' wide
- 100 fpm face velocity
- Average exhaust = 900 cfm or 2cfm/sf

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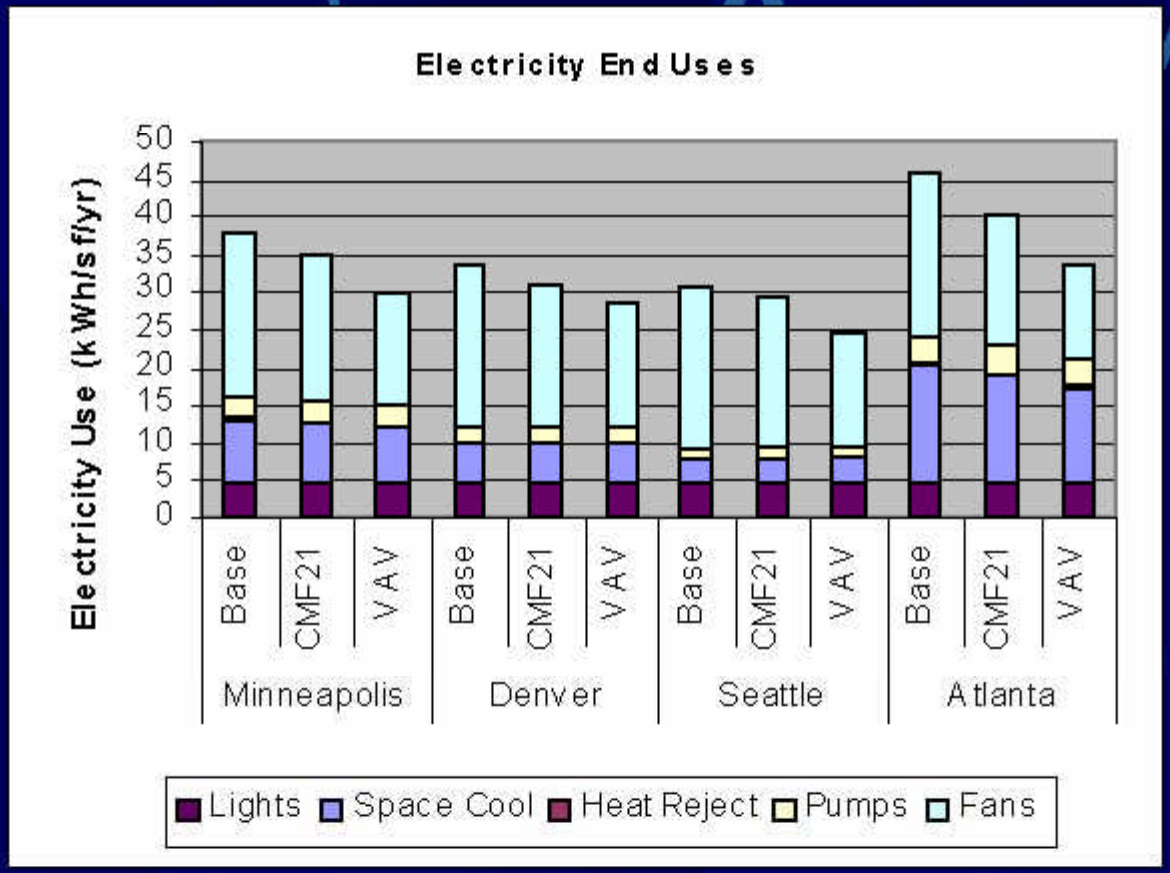
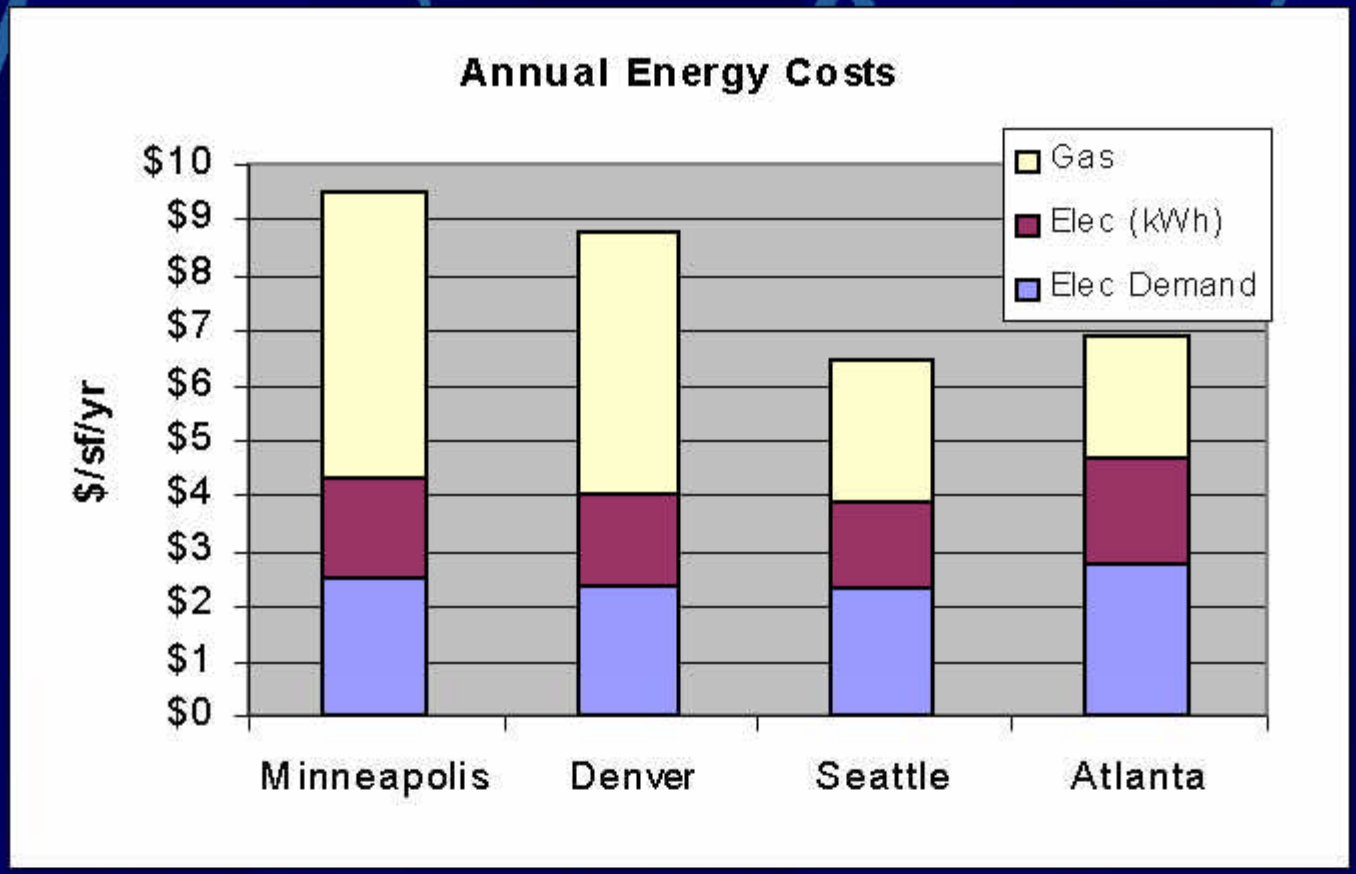
Design Air Flow (cfm/sf)

	Base	Plug 6 W/sf	Plug 3 W/sf
Minneapolis	2.1	2.0	2.0
Denver	2.5	2.1	2.0
Seattle	2.1	2.0	2.0
Atlanta	2.1	2.0	2.0

Fan Energy Use



Base Case



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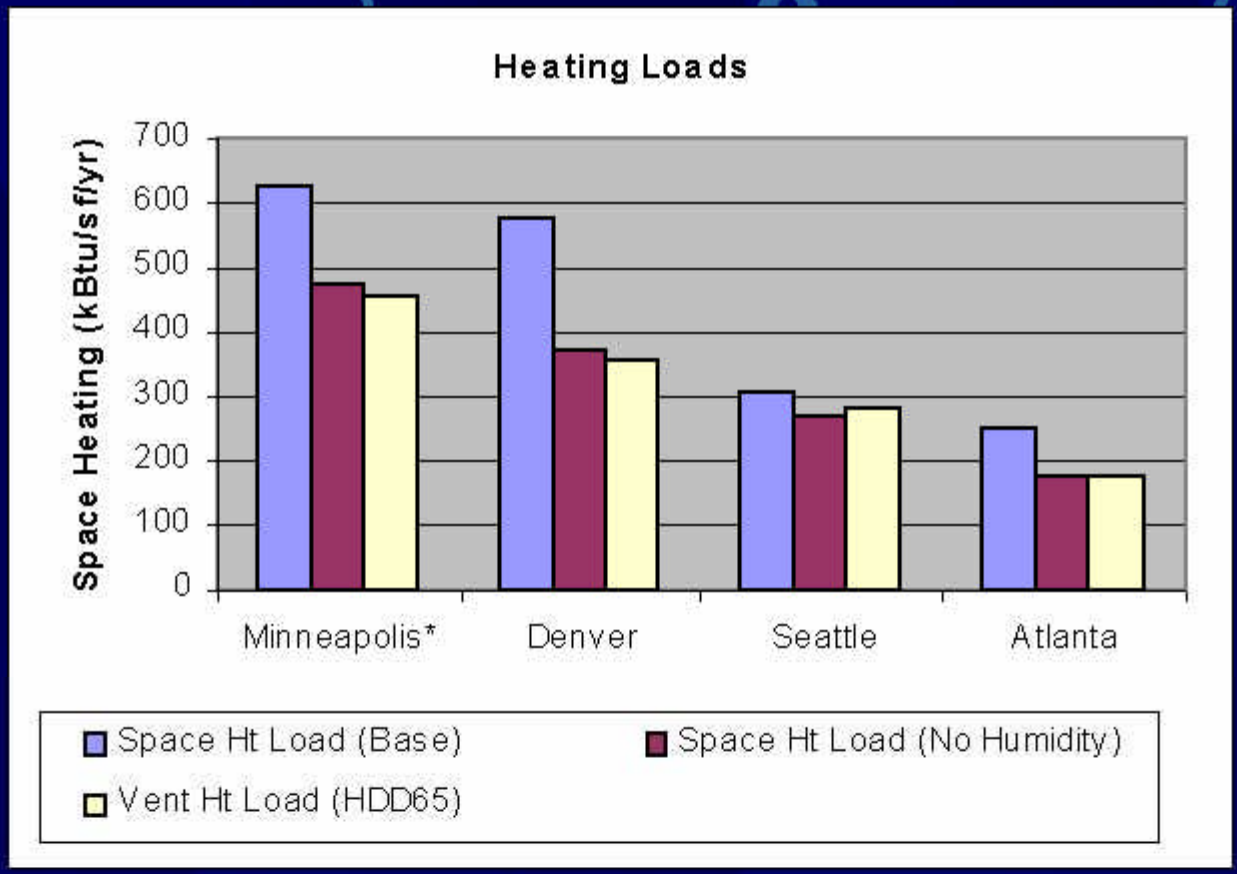
Heating and Humidity Control



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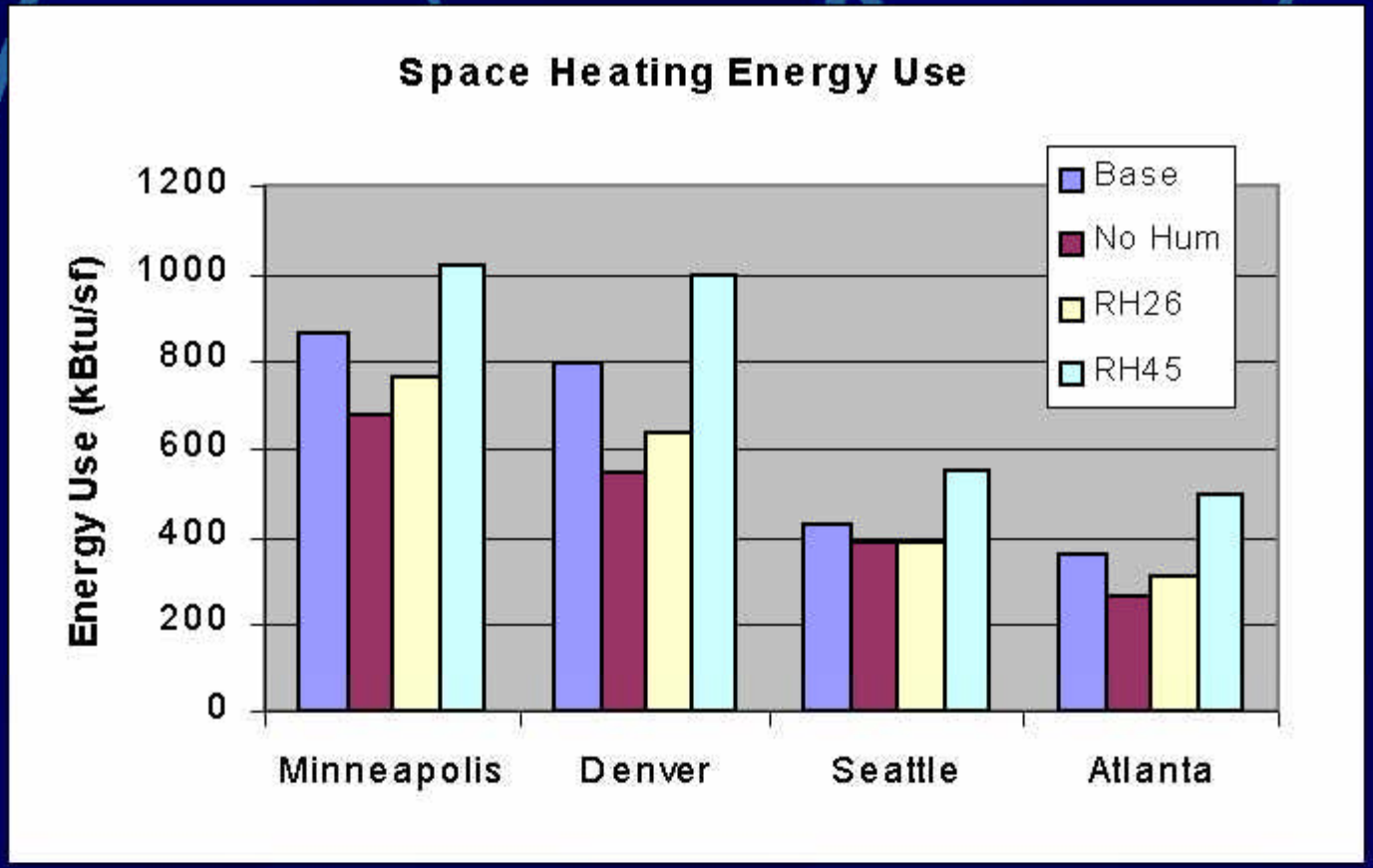
Different Levels of Humidity Control



Efficiency Strategies

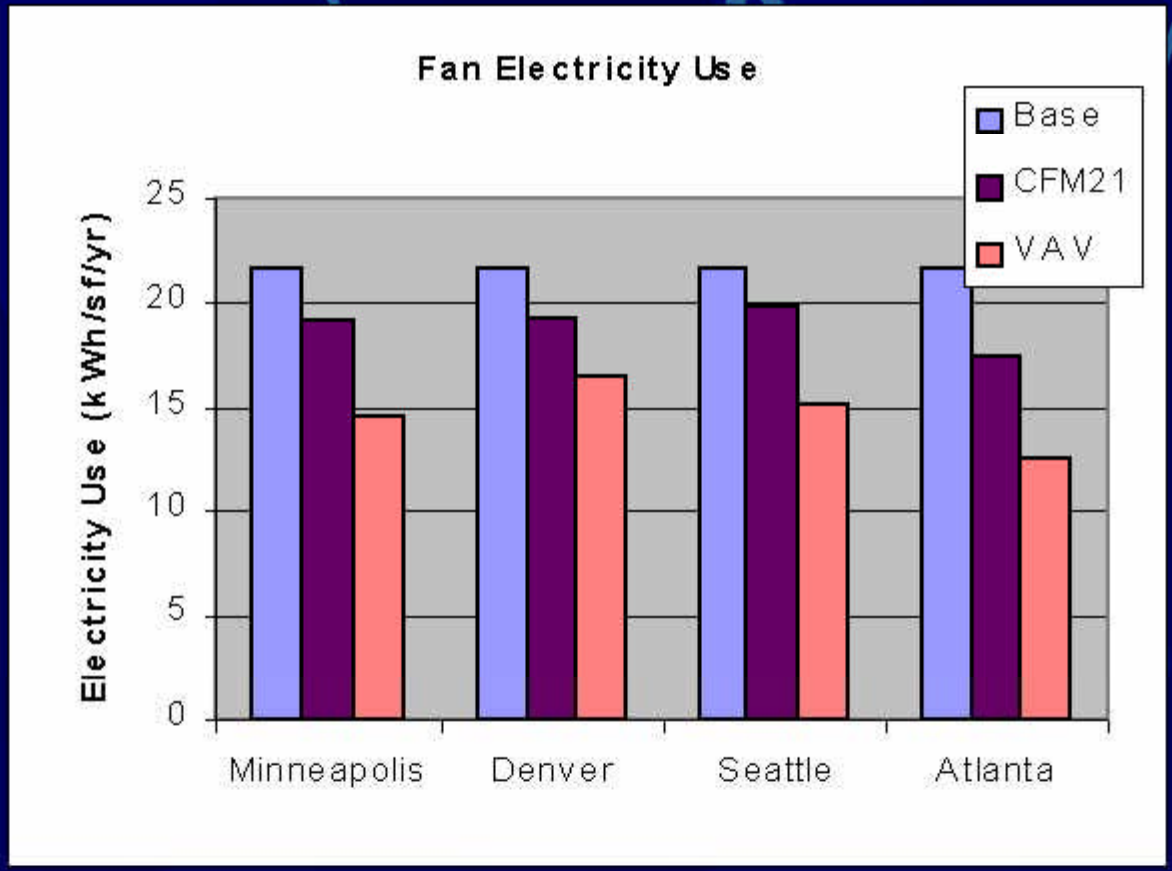
Ventilation

- VAV
- Flow Setback
- Low pressure drop

Energy Recovery

- Enthalpy Wheel
- Heat Pipe
- Run-Around Loop
- Condenser Water

VAV and Flow Setback



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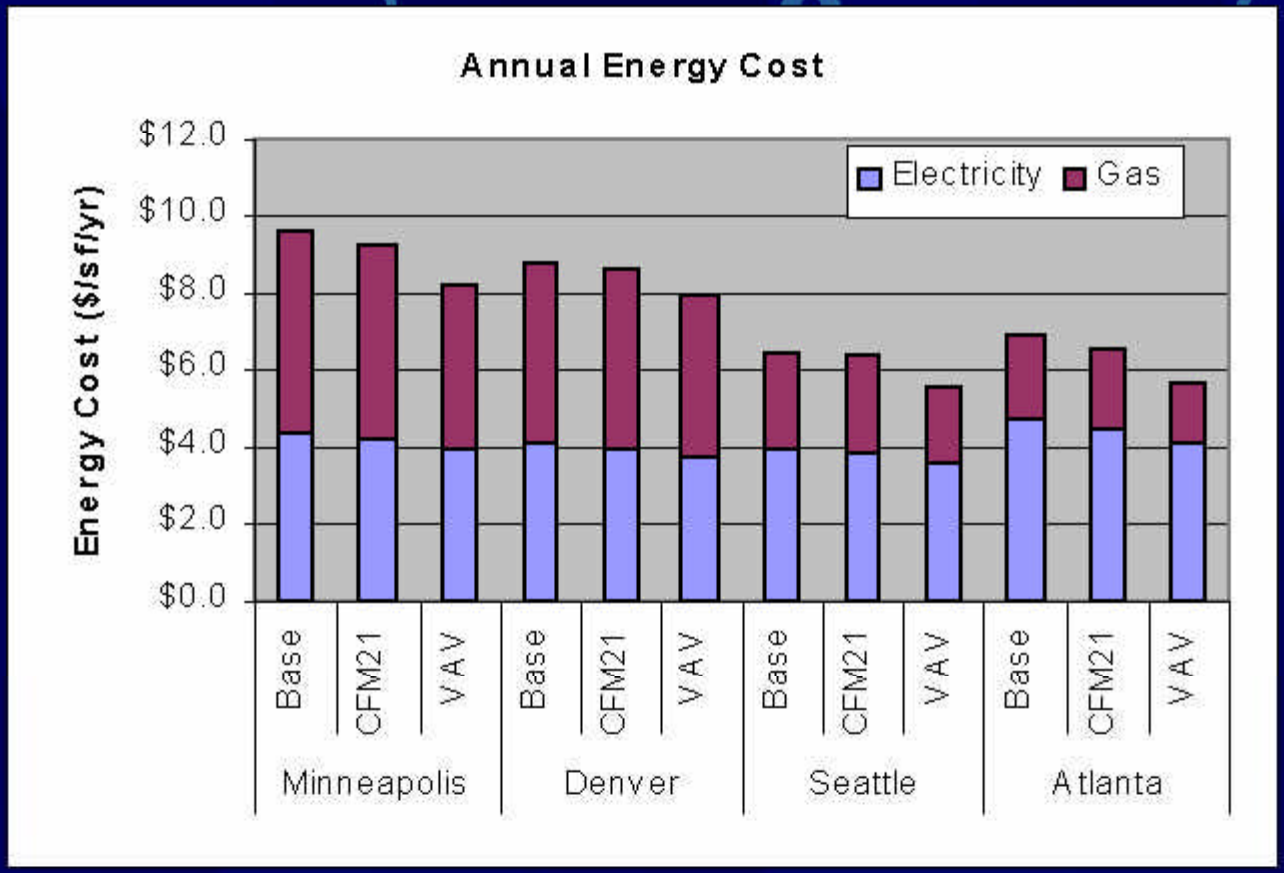
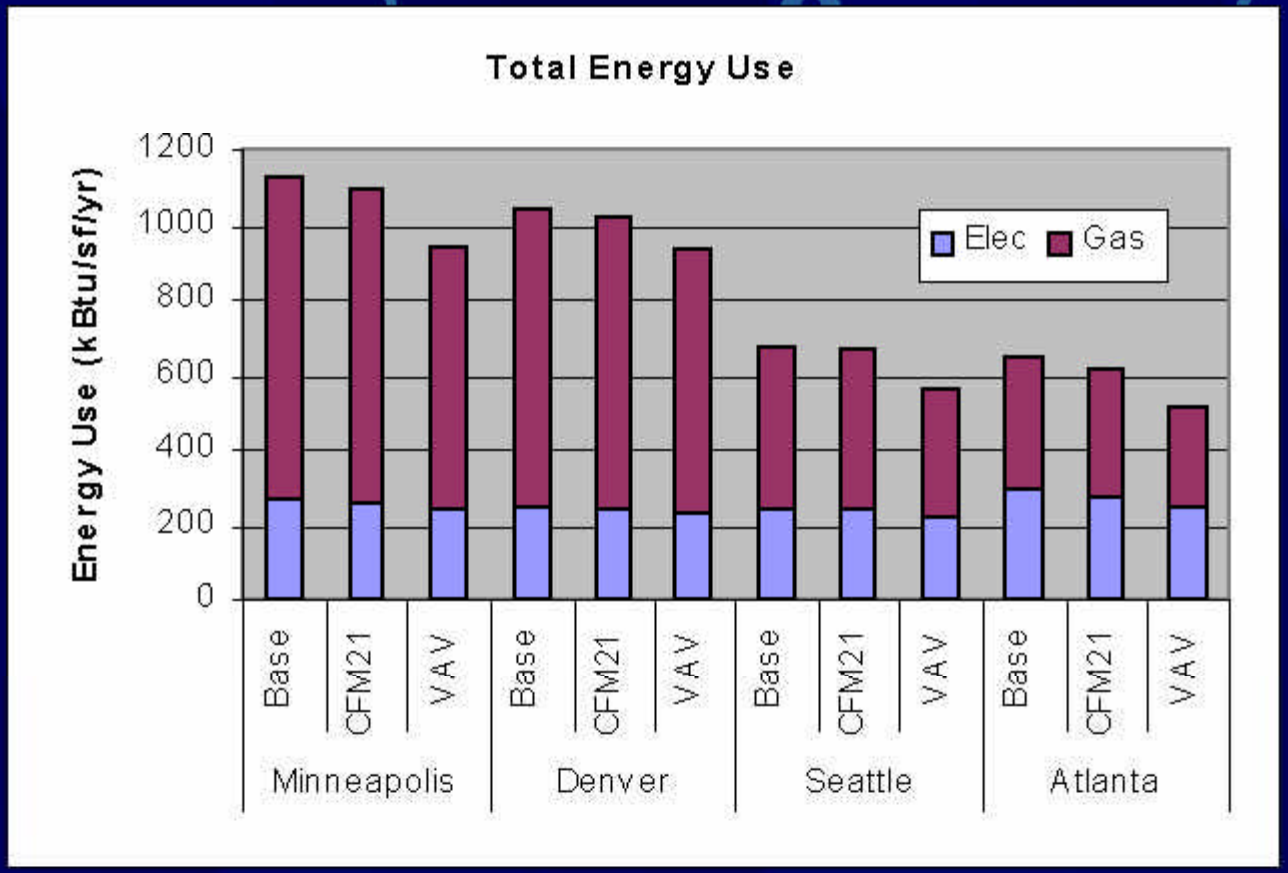
Annual Energy Costs



Total Energy Use



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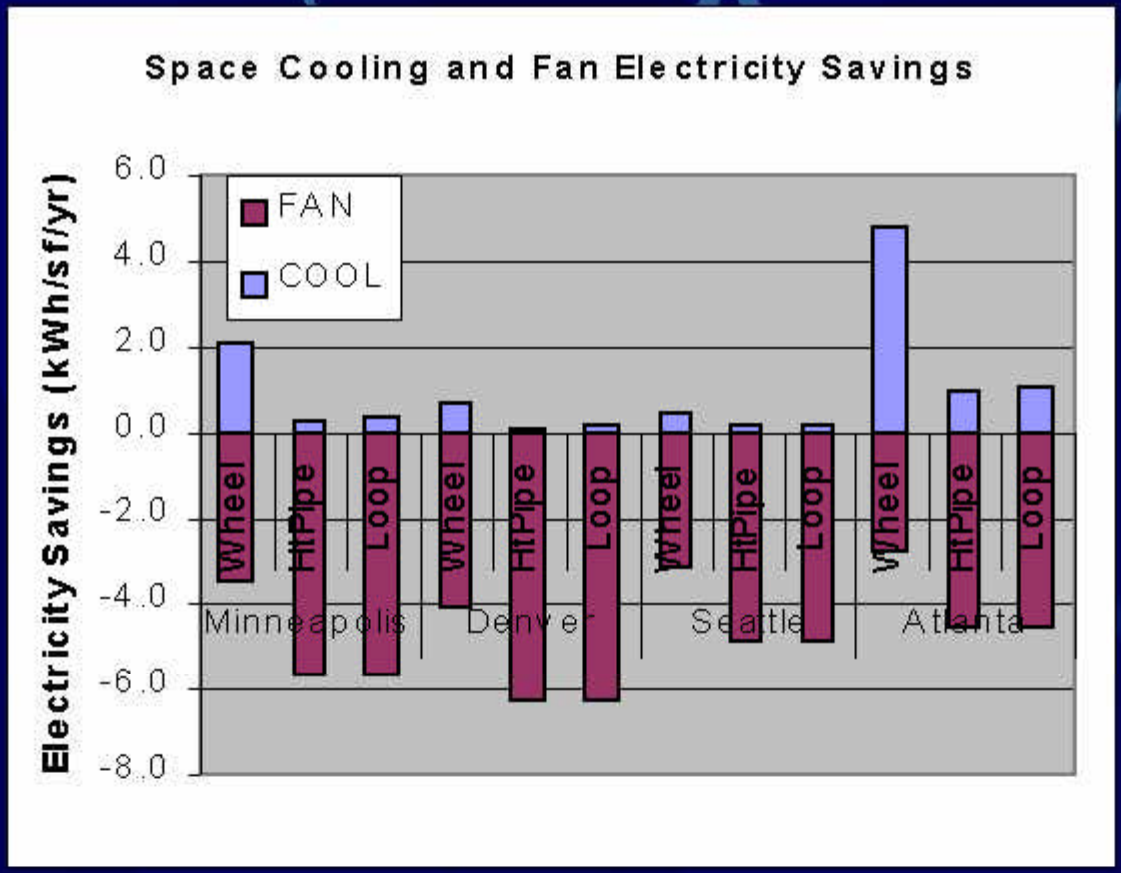
Energy Recovery Ventilation



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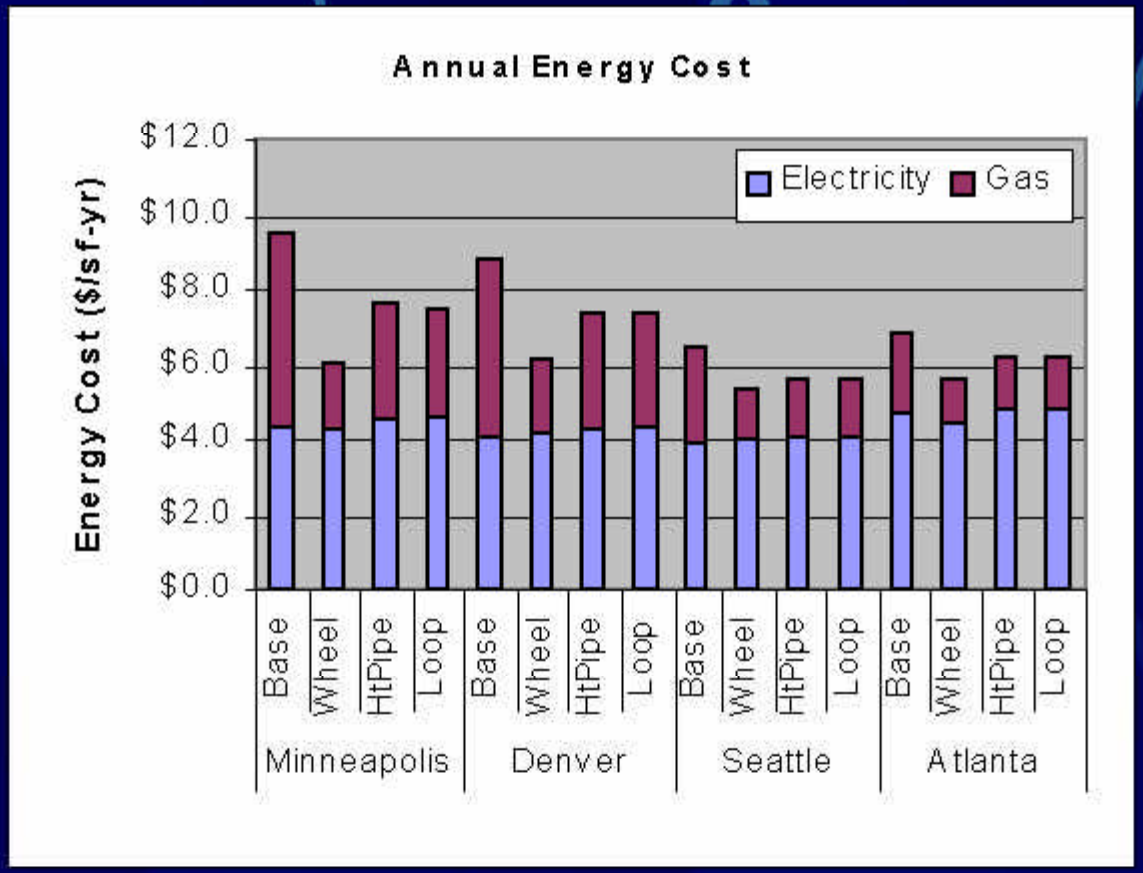
ERV Energy Costs



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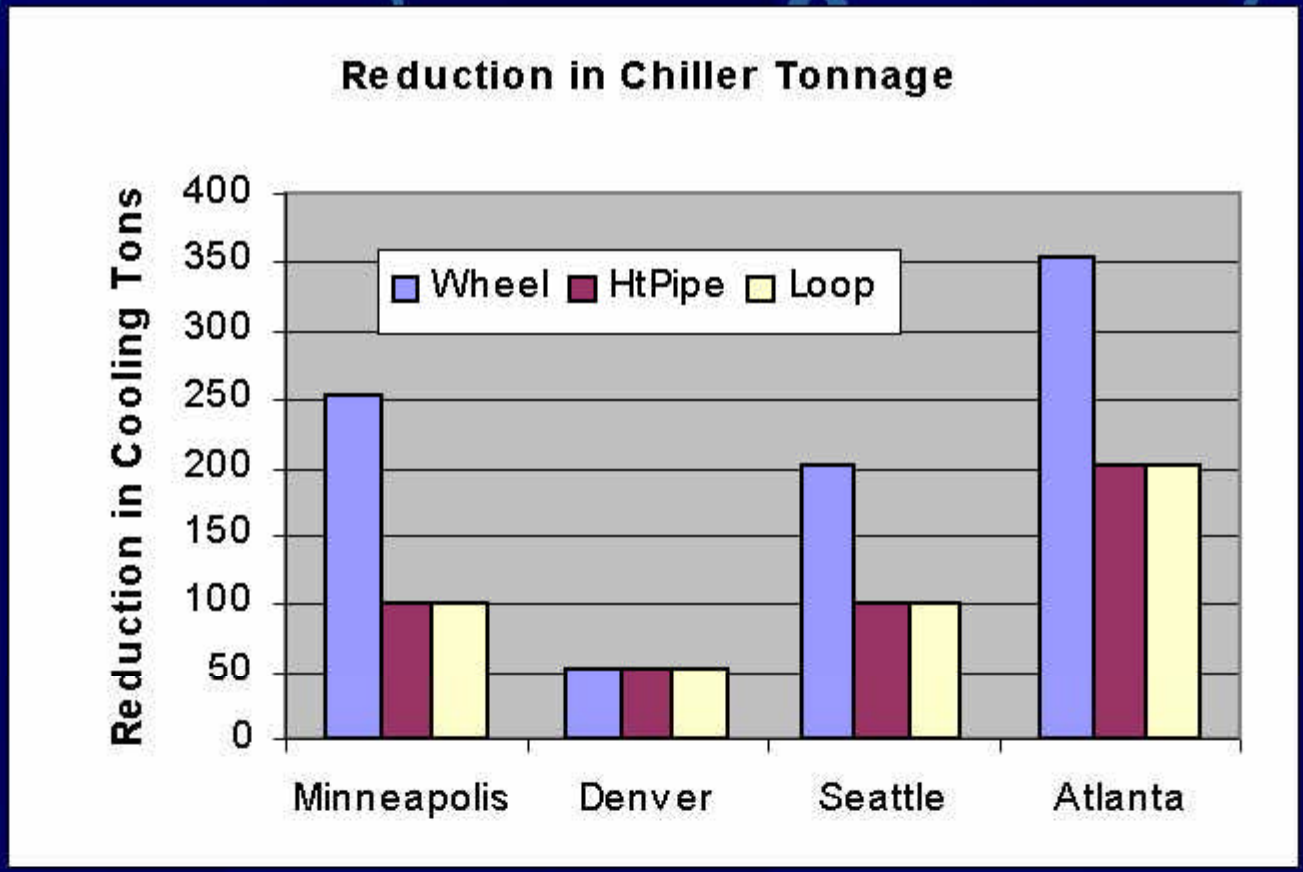
Downsize Chilled Water System



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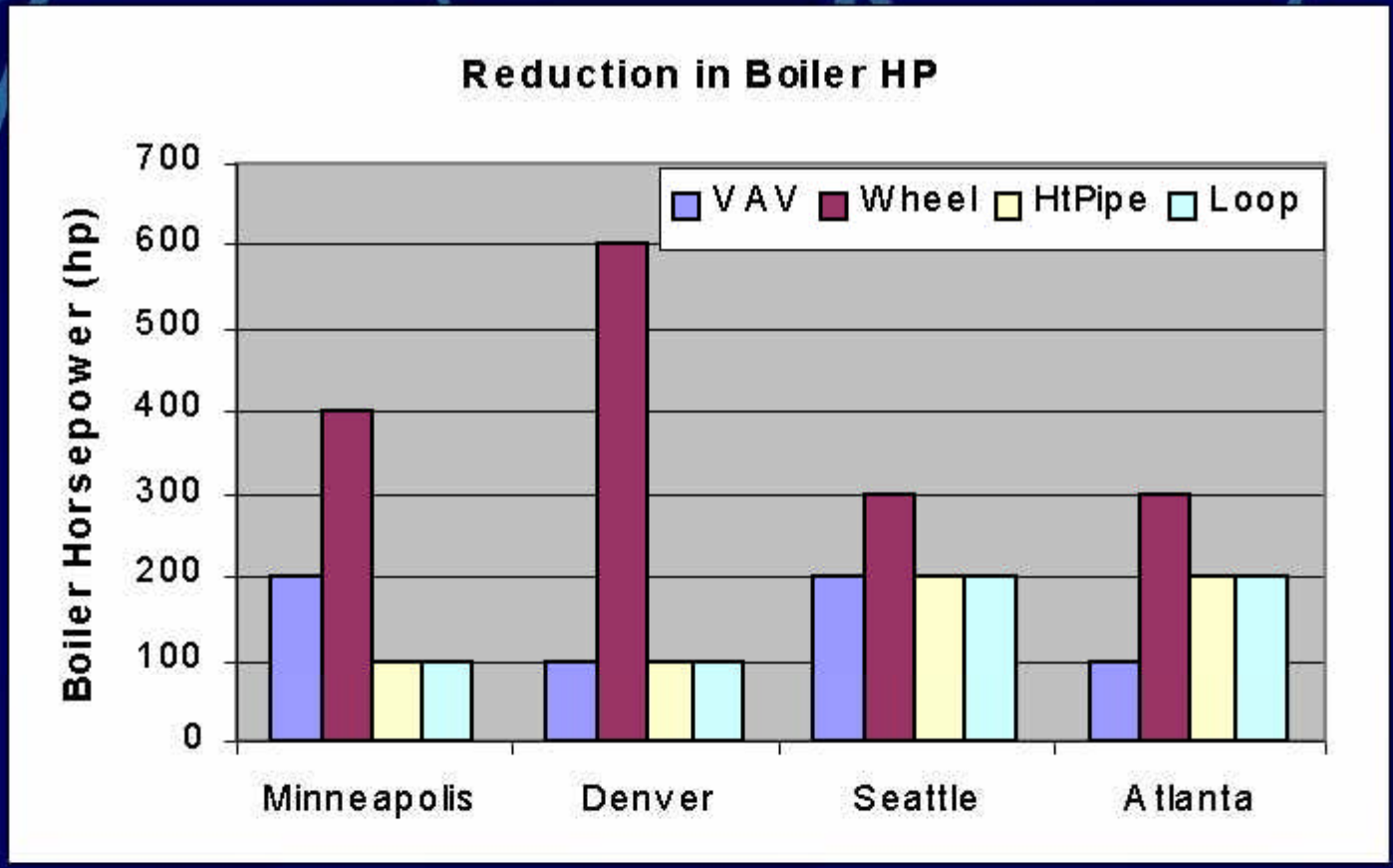
Downsize Hot Water System



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Conclusion

Present Value, $/sf

	Minneapolis	Denver	Seattle	Atlanta
VAV	$5.4	$1.2	$2.5	$4.0
Wheel	$18.3	$10.5	$3.4	$5.6
Adv Wheel	$22.4	$11.9	$4.5	$10.0
Adv Loop	$15.5	$7.0	$4.3	$7.5